October 21, 2015

VIA ELECTRONIC FILING

Marlene H. Dortch Secretary Federal Communications Commission 445 12th Street, S.W. Washington, DC 20554

RE: Office of Engineering and Technology and Wireless Telecommunications
Bureau Seek Information on Current Trends In LTE-U and LAA Technology,
ET Docket No. 15-105

Dear Ms. Dortch:

The Commission has long recognized that the spectrum bands designated for unlicensed use could become subject to the "tragedy of the commons." In the classic formulation of this concept, the commons provided adequate supply for users to graze their cattle, but there was no bar to any individual user grazing additional cattle on the commons. No limitations on grazing, let alone any rational rules of resource management, led to the ruination of the commons for all users. In the context of unlicensed spectrum, this could take the form of uncoordinated market participants deploying technologies in a manner that creates "interference and overcrowding" that "stifle innovation and development."

See, e.g., In the Matter of Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range, Notice of Proposed Rulemaking, 11 FCC Rcd. 7205, ¶ 55 (1996) (explaining that, without appropriate safeguards, wireless operation in unlicensed spectrum "might translate to a situation where users have little or no incentive to make socially beneficial investments in technology or to use the spectrum in a more efficient manner if they do not derive a direct benefit from such investments").

See Garrett Hardin, The Tragedy of the Commons, 162 SCI. 1243 (1968); see also Douglas C. Sicker et al., "Examining the Wireless Commons," at 2-3 (TPRC 2006), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2103824 ("[W]hen each individual who wants to use a common resource captures a private gain that exceeds his or her portion of a shared cost, all individuals have an incentive to increase usage until the resource is depleted.").

FCC Spectrum Policy Task Force, Report of the Unlicensed Devices and Experimental Licenses Working Group, at 11 (Nov. 15, 2002); *see also* Philip J. Weiser & Dale N. Hatfield,

Parties have proposed a variety of strategies for avoiding this outcome, ranging from calls for privatization to calls for command-and-control regulation. Between these two extremes is a middle-ground path of establishing straightforward rules of device eligibility, encouraging industry to develop appropriate norms of conduct and mechanisms for managing the use of the commons, and then largely staying out of the way as self-regulation and innovation take hold.

This middle-ground path is precisely the course the Commission took with respect to the unlicensed spectrum commons under Part 15 of its rules. The Commission has wisely coupled its hands-off approach to unlicensed technologies with strong support for industry participation in open, collaborative standards bodies through which harmful interference can be avoided or rectified.⁴ And this approach has been extremely successful. As the Commission observed in 2008, "the development of industry standards for broadband unlicensed devices . . . has enabled the introduction of a host of new unlicensed wireless broadband products[.]" These innovations were the direct result of industry-led efforts, working through the Institute of Electrical and Electronics Engineers ("IEEE"), to develop the 802.11 standards. The success of this cooperative effort is self-evident to every American who has used Wi-Fi-enabled devices in homes, businesses, and public spaces across the country. Importantly, the incredible expansion

[&]quot;Policing the Spectrum Commons," 74 FORDHAM L. REV. 663, 674 (2005) (explaining how "tragedy of the commons" concerns could arise in the unlicensed bands).

See, e.g., In the Matter of Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range, Report and Order, 12 FCC Rcd. 1576, ¶ 71 (1997) ("[W]e continue to encourage industry to develop appropriate etiquette protocols through a cooperative consensus process."); In the Matter of Modification of Parts 2 & 3 of Commission's Rules for Unlicensed Devices & Equipment Approval, Notice of Proposed Rulemaking, 18 FCC Rcd. 18910, ¶ 43 (2003) ("We observe that industry has developed standards such as Bluetooth and the 802.11 family of standards, which fit within the framework of our rules and provide some measure of assurance that multiple devices can co-exist."); see also Reply Comments of Verizon and Verizon Wireless, GN Dkt. No. 12-268, at 38 (Mar. 12, 2013) ("The Commission's historical reliance on industry standard-setting processes" has gone "hand in hand with its flexible use policy and has promoted the evolution of a strong, vibrant wireless ecosystem.").

In the Matter of Unlicensed Operation in the TV Broadcast Bands; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, Second Report and Order and Memorandum Opinion and Order, 23 FCC Rcd. 16807, ¶ 52 (2008). The Commission made much the same observation in 2004, noting that this model "greatly expanded the number and variety of devices" operating in the unlicensed bands and "enabled the introduction of a host of new wireless Internet products." In the Matter of Unlicensed Operation in the TV Broadcast Bands; Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band, Notice of Proposed Rulemaking, 19 FCC Rcd. 10018, ¶ 9 (2004).

⁶ See Smart City Holdings, LLC, Consent Decree, 30 FCC Rcd. 8382, ¶ 2 (August 18, 2015) ("The Internet is a vital platform for economic growth, innovation, competition, and free

of Wi-Fi has not been at the expense of other innovation in the unlicensed bands, in particular Bluetooth-enabled devices, the success of which reflects the efficacy of its own cooperative standard-setting process.

While today the unlicensed spectrum commons is so valuable that it is susceptible to a classic tragic outcome of unmanaged *overuse*, unlicensed spectrum used to be plagued by a problem of *under-utilization*. Prior to the advent of Wi-Fi, these bands supported a number of useful but low bit-rate devices like garage-door openers, cordless telephones, and the like, which led some to refer to this spectrum as the "junk bands." The Part 15 rules established a framework in which innovation could take hold, but it was the open, collaborative development of the 802.11 standards that ultimately gave rise to the tremendous convenience that consumers now experience with broadband access using unlicensed spectrum. This industry-based standards body approach was especially important given that high bit-rate broadband access devices using the unlicensed bands have a higher potential to generate or to be impaired by interference. As CTIA has explained, "[t]he considerable success of the unlicensed wireless ecosystem can be attributed to the tireless efforts of industry-based standards bodies to develop standards and protocols necessary to ensure that varying wireless technologies coexist without harmful interference."

Thus, the miracle of Wi-Fi, which is largely responsible for delivering over \$140 billion per year in economic value to the United States alone, ⁹ is in many ways the product of putting

expression. Wi-Fi is an essential access ramp to that platform. Wi-Fi networks have proliferated in places accessible to the public, such as restaurants, coffee shops, malls, train stations, hotels, airports, convention centers, and parks.").

- See Remarks of Commissioner Jessica Rosenworcel, Federal Communications Commission, "The Future of Unlicensed Spectrum," Computer History Museum, Mountain View, California (Sept. 11, 2014) ("[S]o little was happening in this spectrum, these airwaves were known in Washington as 'garbage bands.' The conventional wisdom was they were junk.").
- Comments of CTIA The Wireless Association, ET Dkt. No. 15-105, at 7 (June, 11, 2015); *see also* Comments of Verizon, ET Dkt. No. 15-105, at 2 (June, 11, 2015) ("Unlicensed spectrum has been such a tremendous success because operators have voluntarily developed sharing mechanisms that respect one another's legitimate uses of spectrum.").
- See Raul Katz, "Assessment Of The Economic Value Of Unlicensed Spectrum In The United States," Table C (Feb. 2014), available at http://www.wififorward.org/wp-content/uploads/2014/01/Value-of-Unlicensed-Spectrum-to-the-US-Economy-Full-Report.pdf; see also id. (calculating the total economic value contributed by all technologies in the unlicensed bands to exceed \$222 billion per year).

into action what scholars have called a "commons management principle." At their best, open, robust standard-setting processes can serve the role played by effective governance systems for managing common pool resources. The Wi-Fi standard-setting process has been successful in effectuating this principle precisely because its etiquette and protocol standards were developed with the participation of all affected parties. The wi-Fi standard protocol standards were developed with the participation of all affected parties.

Notwithstanding this successful model of private sector cooperation, the leading proponents of LTE-U have taken the opposite approach in the face of substantial concerns about harmful interference to a large class of existing users. While work continues at the 3rd Generation Partnership Project ("3GPP") to develop standards for coexistence between Licensed Assisted Access ("LAA") and Wi-Fi, 13 LTE-U proponents have chosen to press forward unilaterally to deploy their own non-standardized form of unlicensed LTE in the United States. They assert that the self-proclaimed "LTE-U Forum" has established sufficient safeguards to allay any interference concerns, but these claims have not been subject to the rigors of peer review through standard-setting bodies like the 3GPP or IEEE. The LTE-U Forum is not a "standards body" in any recognized sense of the term. 14 Its LTE-U development was conducted

See Brett M. Frischmann, "An Economic Theory of Infrastructure and Commons Management," 88 MINN. L. REV. 917, 937 (Apr. 2005) ("The general values of the commons management principle are that it maintains openness, does not discriminate among users or uses of the resource, and eliminates the need to obtain approval or a license to use the resource. Generally, managing infrastructure resources in an openly accessible manner eliminates the need to rely on either market actors or the government to 'pick winners' downstream. In theory, at least, this catalyzes innovation through the creation of and experimentation with new uses. More generally, it facilitates the generation of positive externalities by permitting downstream production of public goods and nonmarket goods that might be stifled under a more restrictive access regime.").

See Paul Milgrom et al., "The Case for Unlicensed Spectrum," at 14 (2011), available at http://web.stanford.edu/~jdlevin/Papers/UnlicensedSpectrum.pdf (summarizing the work of Nobel Laureate Elisabeth Ostrom in this area as follows: "Her work identifies several key principles: the creation of clear rules that respond to local conditions; collective decision-making that allows the participation of most community members; effective monitoring, enforcement, and conflict-resolution mechanisms; and coordination between organizations that manage common-pool resources.").

See generally id. at 27.

See Letter from Rick Chessen, Senior Vice President, Law and Regulatory Policy, NCTA, to Marlene H. Dortch, Secretary, FCC, ET Dkt. No. 15-105 (Sept. 8, 2015) (describing the 3GPP's efforts and attaching a presentation made by cable companies at a recent 3GPP workshop in Beijing).

See Comments of Verizon, ET Dkt. No. 15-105, at 2 (June 11, 2015) (noting that the LTE-U Forum was created by "Verizon and its vendors"); Letter from Paul Nikolich, IEEE 802

behind closed doors without the open collaboration that generally characterizes the standard-setting process. This falls far short of the multi-stakeholder approach that the Commission has sought to promote, and that LTE-U proponents previously endorsed. As Commissioner O'Rielly recently observed, "any coexistence concerns need to be worked out by stakeholders through the standard-setting body."

LTE-U proponents' disregard for the standard-setting bodies for broadband access devices using unlicensed spectrum threatens to cause significant harm to American consumers. While other countries stand to benefit from the coexistence mechanisms being developed by the 3GPP, the unlicensed bands in the United States could fall victim to the "tragedy of the commons" that have been long prophesized, particularly given the scale of potential LTE-U deployment.

After all, while the successful collaboration that gave rise to Wi-Fi may seem preordained in hindsight, it was by no means guaranteed. Political scientists and economists recognize that cooperation and self-regulation are preferred methods of averting collective action problems, but they can be exceedingly difficult to achieve in practice. Collaborative, open efforts among industry players sometimes develop under the right circumstances.¹⁷ However, they can be

LAN/MAN Standards Committee Chairman, to Marlene H. Dortch, Secretary, FCC, WC Dkt. No. 15-105, at 1 (June 3, 2015) ("There has been no coordination between IEEE 802 and any standards body associated with LTE-U, because LTE-U was not developed by a standards body. It is the understanding of IEEE 802 that LTE-U is a proprietary solution that implements a duty cycle approach to medium sharing that does not use appropriate sharing mechanisms to ensure coexistence with IEEE 802.11 family of standards.").

- Verizon has explained that multi-stakeholder approaches are "particularly important" when issues involve "fundamental technical and engineering realities of designing, manufacturing and deploying radiofrequency (RF) networks and devices." Verizon and Verizon Wireless Comments, PS Dkt. No. 07-114, at 8-9 (May 12, 2014); *see also* Comments of Verizon, GN Dkt. No. 14-25, at 9-10 (Mar. 31, 2014) ("Verizon supports [multi-stakeholder mechanisms] as a preferable approach, in many contexts, to traditional regulation. In fact, there is a long history already in addressing issues that arise in the operation and governance of the Internet through collaborative, multi-stakeholder processes, and this more flexible and nimble approach would work well to address many issues that arise in today's communications marketplace").
- Remarks of Commissioner Michael O'Rielly, Federal Communications Commission, Before the Competitive Carrier Association 2015 Annual Convention (Oct. 7, 2015).
- See Robert Axelrod et al., "Setting Standards: Coalition Formation in Standard-Setting Alliances," 41 MGMT. Sci. 1493 (Sept. 1995) (detailing and modeling the conditions under which cooperation in standard-setting is likely to occur).

especially difficult to maintain in industries with strong network effects, ¹⁸ particularly when certain players come to view the payoff of non-cooperation to be higher than the rewards of cooperation. ¹⁹ Scholars have recognized that standard-setting involves both a "problem of collective action associated with creating a public good" and issues in "allocating and appropriating benefits" that flow from that public good. ²⁰ This can quickly devolve into the classic "prisoner's dilemma," because "participants must agree to divide the benefits gained from cooperating in a way that serves not only each private actor's needs but also those of the group as a whole." ²¹ In these situations, "given actors' interdependencies and asymmetric resources, some are unlikely to cooperate," and "those with the most autonomy have a strong incentive to act opportunistically." ²²

The recent actions of LTE-U proponents have put these all-too-predictable dynamics on full display. By circumventing the standard-setting process, these parties are risking a prisoner's dilemma scenario where non-cooperation appears to promote their self-interest while degrading the ecosystem as a whole. But this is not a game theory exercise that consumers can afford LTE-U proponents to play out in the unlicensed bands. It is a course of action that threatens to undermine American consumers' everyday access to the Internet.

[&]quot;Open standards are prone to 'splintering,' or 'fragmentation.' Splintering of a standard refers to the emergence of multiple, incompatible versions of a standardized technology." Carl Shapiro and Hal Varian, *Information Rules* 256 (1998).

[&]quot;Open standards can . . . be 'hijacked' by companies seeking to extend them in proprietary directions, and thus in time gain control over the installed base." *Id.* at 257. *See also* Marcus Maher, "An Analysis of Internet Standardization," 3 V. J. L. & TECH. 5, at ¶ 27 (Spring 1998), *available at* http://www.vjolt.net/vol3/issue/vol3_art5.html#text44 ("[M]arket actors may have no motivation to standardize, despite the gain that society as a whole would realize. Standards organizations could be in a better position to recognize and develop socially beneficial standards.").

D. Linda Garcia et al., "Public and Private Interests in Standard Setting: Conflict or Convergence," at 9 (2005), *available at* http://dlindagarcia.com/wp-content/uploads/privatepublicinterests.pdf.

²¹ *Id*.

Id. See also Fei Teng et al., EECS Department, Northwestern University, "Sharing of Unlicensed Spectrum by Strategic Operators," 2014 IEEE Global Conference on Signal and Information Processing (Dec. 2014), available at http://arxiv.org/pdf/1408.2572.pdf ("Interference between [LTE-U and Wi-Fi] needs to be managed, otherwise WiFi systems will be severely impacted due to WiFi protocol's 'politeness.' More importantly, every LTE-U operator has an incentive to make the maximum use of the spectrum since it is freely available. Without effective cooperation, all are likely to suffer from the tragedy of the commons.").

The Commission should carefully scrutinize this conduct and ensure that Wi-Fi users remain able to experience the full benefit of their networks and current and future devices. Doing so would be consistent with FCC policy and would promote consumer welfare, just as standards-based innovation has done so well in the past. While it is not yet clear what the 3GPP's efforts will yield, those seeking to deploy LTE technology in unlicensed spectrum bands at a minimum should allow this process to run its course. The preferred "commons management" approach in this context is for private actors to make full use of the established tools of cooperation and self-regulation, such that there would be no need for more significant external commons management.

Respectfully submitted,

Boingo Wireless, Inc.

Broadcom Corporation

Google, Inc.

Hewlett-Packard Enterprise

National Cable & Telecommunications Association

Paul Nikolich Consultant/Standards Expert

Ruckus Wireless, Inc.